

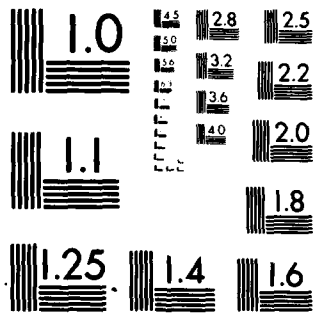
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NATIONAL DAM SAFETY PROGRAM. SUNSET LAKE DAM (NJ00563), PASSAIC--ETC(U)
FEB 80 W A GUINAN DACW61-79-C-0011

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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6. AUTHOR(s) Brook, Morris County Guinan, Warren A. New Jersey. Phase I Inspection Report.		7. PERFORMING ORG. REPORT NUMBER 15
8. PERFORMING ORGANIZATION NAME AND ADDRESS Anderson-Nichols 6 London Rd. Concord, N.H. 03301		9. CONTRACT OR GRANT NUMBER(s) DACW61-79-C-0011
10. CONTROLLING OFFICE NAME AND ADDRESS NJ Department of Environmental Protection Division of Water Resources P.O. Box CN029 Trenton, NJ 08625		11. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
12. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, PA 19106		13. REPORT DATE 11 Feb 80
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18. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.		18a. DECLASSIFICATION/DOWNGRADING SCHEDULE
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams National Dam Safety Program Embankments Sunset Lake Dam, New Jersey Visual Inspection Spillways Structural Analysis Seepage		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

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91 JUL 1980

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Sunset Lake Dam in Morris County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Sunset Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of these inspections is indeed to be in an UNSAFE, non-emergency condition. The dam's stability is considered questionable by the personnel (Consulting Engineer's Staff, State and Federal Engineers) who inspected this structure. Also, the spillway is considered inadequate because a flow equivalent to one percent of the Probable Maximum Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within thirty days from the date of approval of this report the following remedial measures should be completed:

(1) Lower the water level in the lake until remedial measures are completed.

(2) Check the condition of the dam regularly and monitor the wet area at the downstream toe until repairs, rehabilitation, or replacement are completed.

(3) Establish a surveillance system for use during and immediately following periods of heavy rainfall and an emergency action plan and downstream warning program to follow in case of emergency conditions.

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Honorable Brendan T. Byrne

b. The spillway's adequacy should be determined by a qualified professional consultant, engaged by the owner, using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

c. Within 30 days from the date of approval of this report, the following engineering studies and analysis should be initiated to accomplish the following:

- (1) Repair or replacement of the low-level outlet valve.
- (2) Investigation of the cause of the seepage and wet, soft areas at the downstream toe of the dam.
- (3) Removal of trees from entire embankment.
- (4) Provision of adequate freeboard, topwidth and slope protection to prevent overtopping by high water and wave action.
- (5) Repair or replacement of the dry stone masonry wall that retains the downstream slope of the embankment in the vicinity of the low-level outlet pipes at the left abutment.

d. Within three months from the date of approval of this report, the following remedial measures should be completed:

- (1) Remove trees and brush for a distance of 25 feet downstream of the dam, and from a zone 25 feet wide on either side of the discharge channel for a distance of at least 50 feet downstream of the dam or to the nearest property line, whichever is closer.
- (2) Remove trees growing on the banks of the discharge channel downstream of the spillway at the east end of the lake.
- (3) Remove debris from the spillway approach channel.
- (4) Operate the low-level outlet gate to ensure proper operation and flush debris out of the pipe.

e. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

NAPEN-N

• Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congresswoman Fenwick of the Fifth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

SUNSET LAKE DAM (NJ00563)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 8 November 1979 by Anderson-Nichols Co., Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Subsequent inspection of Sunset Lake Dam on 31 January 1980 by Corps and State personnel revealed the dam to be in an UNSAFE, non-emergency condition. This condition, seepage and wet, soft areas on the downstream toe of the dam, if left uncorrected, could result in failure of the dam resulting in possible loss of life and property damage. Until further study can determine the full extent of the problem and possible permanent remedial action, temporary measures were recommended to preclude serious property damage and possible loss of life. The District Engineer notified the Governor's representative by telegram of the UNSAFE condition on 1 February 1980 (Copy attached to this assessment) (Also, an "UNSAFE DAM" data sheet was submitted to the U.S. Army Engineer Division, North Atlantic on 4 February 1980. A copy of this sheet is attached.) Meanwhile, the State notified the owner by letter of the recommendations. The owner has lowered the level of the lake as recommended.

Sunset Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of these inspections is judged to be in an UNSAFE, non-emergency condition. The dam's stability is considered questionable by the personnel (Consulting Engineer's Staff, State and Federal Engineers) who inspected this structure. Also, the spillway is considered inadequate because a flow equivalent to one percent of the Probable Maximum Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within thirty days from the date of approval of this report the following remedial measures should be completed:

- (1) Lower the water level in the lake until remedial measures are completed.
- (2) Check the condition of the dam regularly and monitor the wet area at the downstream toe until repairs, rehabilitation, or replacement are completed.
- (3) Establish a surveillance program for use during and immediately following periods of heavy rainfall and an emergency action plan and downstream warning system to follow in case of emergency conditions.

b. The spillway's adequacy should be determined by a qualified professional consultant, engaged by the owner, using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

c. Within 30 days from the date of approval of this report, the following engineering studies and analysis should be initiated to accomplish the following:

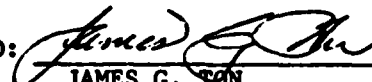
- (1) Repair or replacement of the low-level outlet valve.
- (2) Investigation of the cause of the seepage and wet, soft areas at the downstream toe of the dam.
- (3) Removal of trees from the embankment.
- (4) Provision of adequate freeboard, topwidth and slope protection to prevent overtopping by high water and wave action.
- (5) Repair or replacement of the dry stone masonry wall that retains the downstream slope of the embankment in the vicinity of the low-level outlet pipes at the left abutment.

d. Within three months from the date of approval of this report, the following remedial measures should be completed:

- (1) Remove trees and brush for a distance of 25 feet downstream of the dam, and from a zone 25 feet wide on either side of the discharge channel for a distance of at least 50 feet downstream of the dam or to the nearest property line, whichever is closer.
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- (3) Remove debris from the spillway approach channel.
- (4) Operate the low-level outlet gate to ensure proper operation and flush debris out of the pipe.

e. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

APPROVED:


JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE:

7 JULY 1980



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-N

19 FEB 1980

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Joint Inspection of Sunset Lake Dam (NJ 00563), located in the borough of Mountain Lakes, Morris County, New Jersey, by representatives of this office and the New Jersey Department of Environmental Protection 31 January 1980, revealed the dam to be in an UNSAFE, non-emergency condition. This condition, seepage and wet, soft areas on the downstream toe of the dam, if left uncorrected, could result in failure of the dam with subsequent possible loss of life and property damage.

Until further study can determine the full extent of the problem and possible permanent remedial actions, the following temporary measures, as a minimum, are recommended to preclude serious property damage and possible loss of life:

- a. Drawdown the lake one foot within one week by opening the upper outlet pipe on the eastern end of the embankment.
- b. Drawdown the lake an additional foot within two weeks by opening the outlet pipe in the emergency spillway. If the outlet pipes cannot be opened then a suitable sized notch should be made in the concrete emergency spillway draining into Olive Lake to effect the specified drawdown.
- c. Local authorities should immediately prepare an emergency warning and evacuation plan including a surveillance program for use during periods of heavy rainfall.

Mr. John O'Dowd P.E., Chief Bureau of Flood Plain Management, New Jersey Department of Environmental Protection was notified of the condition by telephone and telegram on 1 February 1980.

^v
NAPEN-N
Honorable Brendan T. Byrne

Your cooperation in implementing these measures will be appreciated.

Sincerely,



JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copy Furnished:
Mr. John O'Dowd P.E.
Chief Bureau of Flood Plain Management
Department of Environmental Protection
1471 Prospect Street
Trenton, New Jersey 08625

MAILGRAM SERVICE CENTER
MIDDLETOWN, VA. 22645

22

4-0586855032002 02/01/80 ICS IPMMTZZ CSP PHAB
1 2155973796 MGM TDMT PHILADELPIA PA 02-01 0446P EST

ARMY CORPS OF ENGINEERS BRIAN HEVERIN
CUSTOM HOUSE 2ND AND CHESTNUT STS
PHILADELPHIA PA 19106

THIS MAILGRAM IS A CONFIRMATION COPY OF THE FOLLOWING MESSAGE:

2155973796 TDMT PHILADELPIA PA 207 02-01 0446P EST
PMS JOHN D'DOWD PE CHIEF BUREAU FLOOD PLAINS MGMNT NJ DEPT OF
ENVIRONMENTAL PROTECTION RPT DLY MGM, ADDRESS UNKNOWN PLS ASSIST, DLR
PROSPECT ST
TRENTON NJ 08625

UNCLASS

INSPECTION OF SUNSET LAKE DAM NJ00563, LOCATED IN THE BOROUGH OF
MOUNTAIN LAKES, MORRIS COUNTY, NJ, REVEALED THE DAM TO BE IN AN
UNSAFE, NON-EMERGENCY CONDITION. THIS CONDITION, SEEPAGE AND WET,
SOFT AREAS ON THE DOWNSTREAM TOE OF THE DAM IF LEFT UNCORRECTED COULD
RESULT IN FAILURE OF THE DAM WITH SUBSEQUENT POSSIBLE LOSS OF LIFE
AND PROPERTY DAMAGE. UNTIL FURTHER STUDY CAN DETERMINE FULL EXTENT
OF THE PROBLEM AND POSSIBLE PERMANENT REMEDIAL ACTION THE FOLLOWING
TEMPORARY MEASURES AS A MINIMUM ARE RECOMMENDED TO PRECLUDE SERIOUS
PROPERTY DAMAGE AND POSSIBLE LOSS OF LIFE:

A DRAWDOWN THE LAKE ONE FOOT WITHIN ONE WEEK BY OPENING THE OUTLET
PIPE ON THE EASTERN END OF THE EMBANKMENT

B DRAWDOWN THE LAKE AN ADDITIONAL FOOT WITHIN TWO WEEKS BY OPENING
THE OUTLET PIPE IN THE EMERGENCY SPILLWAY. IF THE OUTLET PIPES
CANNOT BE OPENED, THEN A SUITABLY SIZED NOTCH SHOULD BE MADE IN THE
CONCRETE EMERGENCY SPILLWAY DRAINING INTO OLIVE LAKE TO EFFECT THE
SPECIFIED DRAWDOWN

C LOCAL AUTHORITIES SHOULD PREPARE AN EMERGENCY WARNING AND
EVACUATION PLAN IMMEDIATELY, INCLUDING A SURVEILLANCE PROGRAM FOR USE
DURING PERIODS OF HEAVY RAINFALL.

A LETTER WILL BE SENT TO GOVERNOR BYRNE FULLY EXPLAINING THE
SITUATION. THIS TELEGRAM IS SENT SO YOU MAY EXPEDITE ACTION

JAMES G TON COL COE
CUSTOM HOUSE 2ND AND CHESTNUT STS
PHILADELPHIA PA 19106

16148 EST

MGMCOMP MGM

UNSAFE DAM REPORT
NATIONAL PROGRAM OF INSPECTION OF DAMS

a. NAME: Sunset Lake Dam b. ID NO.: NJ00563 c. LOCATION State: NJ County: Morris
d. HEIGHT: 7.5 feet e. MAXIMUM IMPOUNDMENT CAPACITY: 74 ac-ft
f. TYPE: Earth Embankment g. OWNER: Borough of Mountain Lakes
h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 1 Feb 80.
i. URGENCY CATEGORY: Non-Emergency j. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT:
Seepage and wet, soft areas on the downstream toe of the dam.
k. DESCRIPTION OF DANGER INVOLVED: Lake level is within inches of the top of the dam. Overtopping and failure could result in loss of life and property damages to residences downstream of dam.
l. RECOMMENDATIONS GIVEN TO GOVERNOR: Letter being prepared to Governor stating full problem with temporary remedial action required. Governor's Representative informed of situation by telephone and telegram on 1 Feb 80.

m. EMERGENCY ACTIONS TAKEN: Governor's Representative notified by telephone and telegram to tell the owner to open outlet pipes to lower the lake level.

n. REMEDIAL ACTIONS TAKEN: Governor's Representative will notify owner to open outlet pipes to drawdown lake level approximately 2 feet.

o. REMARKS: As additional actions and information becomes available, this report will be updated.

T.B.H.
T. B. Heverin
Coordinator, Dam Inspection Program
U.S.A.E.D., Philadelphia
4 February 1980

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Sunset Lake Dam
Identification No.: NJ00563
State Located: New Jersey
County Located: Morris
Stream: Troy Brook
River Basin: Passaic
Date of Inspection: November 8, 1979

ASSESSMENT OF GENERAL CONDITIONS

Sunset Lake Dam is a 65-year old earthfill dam, and is in very poor condition. It is small in size and is recommended to be downgraded to Significant Hazard. The area at the downstream toe of the dam is generally wet and soft and has seepage discharging at several locations, and therefore the dam is considered to be in an unsafe, non-emergency condition. Trees up to 3 feet in diameter are growing on the crest of the dam and the downstream slope of the dam. The crest of the dam was generally not more than a few inches higher than the level of the water in the lake at the time of the inspection. Near the center of the dam the crest dips slightly and the lake level was at the crest of the embankment. A railroad tie has been placed across this low area, however, water was leaking under and around the ends of the tie. Two low-level outlet pipes, located at the east end of the dam, appeared to be inoperable. The inlet to the low-level outlet pipe of the emergency spillway, which is located at the east end of the lake, was buried in debris and sediment. The emergency spillway is capable of passing less than 1% of the PMF without causing the dam to overtop. Dam failure resulting from overtopping would cause substantial property damage to homes lying immediately downstream of the dam. The spillway is clearly inadequate.

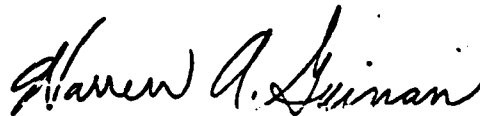
We recommend that the owner immediately engage a professional engineer qualified in the design and construction of dams to design and implement a complete rehabilitation or replacement of the existing dam, including the following: repair or replacement of the low-level outlet pipes and valves at the left abutment; investigation of the cause of the seepage and wet, soft areas at the downstream toe of the dam; removal of the trees from the entire embankment; provision of adequate freeboard, topwidth, and slope protection to prevent overtopping by high water and wave action; repair or replacement of the dry stone masonry wall that retains the downstream slope of the embankment in the vicinity of the low-level outlet pipes at the left abutment; and reassessment of the hydrologic and hydraulic characteristics of the watershed and reservoir so that adequate spillway capacity is provided in the rehabilitated structure.

We further recommend that as a part of operating and maintenance procedures, the owner should undertake the following immediately: lower the water level in the lake until remedial measures can be effected; check the condition of the dam regularly and monitor the wet area at the downstream toe until repairs, or rehabilitation, or replacement are completed; establish a surveillance program for use during and immediately following periods of heavy rainfall and also a warning program to follow in case of emergency conditions.

Starting soon the owner should remove trees and brush for a distance of 25 feet downstream of the dam, and from a zone 25 feet wide on either side of the discharge channel for a distance of at least 50 feet downstream from the dam or to the nearest property line, whichever is closer. He should also remove debris from the emergency spillway approach channel and operate the low-level outlet gate at the emergency spillway to insure proper operation and to flush debris out of the pipes.

Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.

ANDERSON-NICHOLS COMPANY, INC.



Warren A. Guinan, P.E.
Project Manager
New Jersey No. 16848



DAM

OVERVIEW
SUNSET LAKE DAM

NOV 08 1979

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PHASE I INSPECTION REPORT
SUNSET LAKE DAM N.J. NO. 25-121 FED ID NO. NJ00563

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
SUNSET LAKE DAM
US #NJ00563

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Sunset Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 26 October 1979 under Contract FPM No. 39, dated 28 June 1979. This authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 7 November 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to safety of Sunset Lake Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations, and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Sunset Lake Dam is a 65 year old earthfill dam, which is approximately 165 feet long, has a structural height of 8 feet and a hydraulic height of 7.5 feet. The top width of the dam is irregular from 3-7 feet. The visible part of the upstream face is vertical. The downstream face slopes at 3H:1V. Two low-level outlet pipes and the dry stone masonry which retains the downstream slope of the dam in their vicinity are located at the east end of the dam. The channel downstream of the dam is overgrown with brush and trees and is poorly defined. A RCP culvert (16" in diameter) located approximately 200 feet downstream of the dam passes beneath East Shore Road. A concrete emergency spillway is located at the east end of the lake. The spillway crest is 7.8 feet long and 1 foot wide. The low-level outlet pipe located under the spillway is 12" in diameter. Approximately 70 feet downstream of the emergency spillway, flow passes beneath East Shore Road through a 50-foot long, 3-foot diameter RCP culvert just before discharging into Olive Lake. The watershed above the lake is gently to moderately sloping and wooded. Essential features of the dam are shown in Figure 1.

b. Location. The dam is located in the Borough of Mountain Lakes, Morris County, New Jersey, on Troy Brook, immediately downstream of Crystal Lake Dam. It has coordinates of north latitude 40° 53.2' and west longitude 74° 27.2'. A location map is shown in Figure 2.

c. Size Classification. Sunset Lake Dam is classified as being small in size, as defined in the Recommended Guidelines for Safety Inspection of Dams, on the basis of its hydraulic height of 7.5 feet, which is less than 40 feet, and its storage volume of 74 acre-feet, which is less than 1,000 acre-feet, but more than 50 acre-feet.

d. Hazard Classification. Visual inspection of the downstream area indicates that a failure of Sunset Lake Dam could cause extensive property damage to several houses located approximately 250 feet downstream of the dam. The first floor elevations of the houses are about 5-6 feet above the poorly defined streambed and the general area is broad and flat. Loss of a few lives is possible, but unlikely. A failure of Sunset Lake Dam could also cause damage to East Shore Road and a culvert located approximately 200 feet downstream of the dam. Sunset Lake Dam is thus classified as Significant Hazard.

e. Ownership. According to a deed for the property of Dr. and Mrs. Adrian M. Sabety, which lies adjacent to the east end of the dam, the Borough of Mountain Lakes has a right of way for access to the dam. This would indicate that the Borough owns the dam. Borough Manager, William F. O'Brian, was unsure of the town's responsibility and at the time of this writing was checking into the matter. Borough officials may be contacted at Borough Hall, Mountain Lakes, New Jersey, 07046. Phone: (201) 334-3131.

f. Purpose of Dam. The dam was originally constructed to impound a pond for a public swimming pool. Presently, the lake also serves a recreational purpose, but all land around the lake appears to be privately owned.

g. Design and Construction History. Reference data, Dams in New Jersey, No. 25-121 from New Jersey Department of Environmental Protection files, dated June 15, 1939, notes that the dam was built by Senator Thomas Hillary in 1914. No plans, hydraulic or hydrologic data for the original construction were found.

h. Normal Operational Procedures. According to the Public Works Superintendent, Carl Danser, no formal operating procedures are followed.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. Information derived from a report entitled "Engineering Geology of the Northeast Corridor, Washington, D.C. to Boston, MA" and the Geologic Map of New Jersey (Lewis and Kummel, 1912) indicate that soils within the immediate site area consist of till grading laterally to sand and gravel. These soils form a nearly continuous band which is believed to be an end moraine for the last continental glaciation. Although no outcrops were observed during inspection of this dam, the previously mentioned report indicates that the underlying bedrock consists of granitoid gneiss with associated migmatite, granulite, amphibolite, and granitic rocks of Precambrian age.

1.3 Pertinent Data

a. Drainage Area - .37 square mile

b. Discharge at Damsite - (cfs)

Maximum flood at damsite - unknown

Emergency spillway capacity at normal pool elevation (as during inspection, with low-level pipe not operating) -.8

Emergency spillway capacity at maximum pool (top of dam) -.8

c. Elevation (ft. NGVD)

Top of dam - 522.3

Crest of emergency spillway - 522.2

Maximum pool - design surcharge ($\frac{1}{2}$ PMF) - 523.4

Recreation pool - (at time of inspection) - 522.3

Streambed at centerline of dam (downstream) - 514.8

Maximum tailwater (estimated) - 515.8

d. Reservoir Length (feet)

Maximum pool - 1,000

Recreational - 950

e. Storage (acre-feet)

Recreational pool - 74

Design surcharge ($\frac{1}{2}$ PMF) - 92

Top of dam - 74

Crest of emergency spillway - 73.5

f. Reservoir Surface (acres)

Top of dam - 14.7

Recreation pool - 14.7

Crest of emergency spillway - 14.7

g. Dam

Type - earthfill

Length - 165+ feet

Height - hydraulic - 7.5 feet

- structural - 8.3 feet

Top width - irregular - 3-7 feet

Side slope - upstream - vertical (visible part)

- downstream - 3H:1V

Zoning - unknown

Impervious core - unknown

Cutoff - unknown

Grout curtain - unknown

h. Emergency Spillway

Type - concrete free overflow

Length of weir - 7.8 feet

Crest elevation - 522.2 feet NGVD

Upstream channel - Sunset Lake

Downstream channel - Olive Lake

i. Regulating Outlets

At the emergency spillway - one low-level outlet pipe
12" in diameter (not discharging during inspection)

Operating facilities - unknown - not visible

At the dam - two low-level outlet pipes 12" in diameter
(not discharging during inspection)

Operating facilities - unknown - not visible

SECTION 2 ENGINEERING DATA

2.1 Design

No original engineering design data or plans were available.

2.2 Construction

No original construction data were found.

2.3 Operation

No engineering operational data were found.

2.4 Evaluation

a. Availability. A search of New Jersey Department of Environmental Protection files and contact with community officials revealed a very limited amount of information.

b. Adequacy. The information available was such that the evaluation of this dam was based solely on visual observations.

SECTION 3 VISUAL INSPECTION

3.1 Findings

a. Dam. The area at the downstream toe of the dam is generally wet and soft and some seepage water is discharging. Trees are growing on the crest of the dam, on the downstream slope, and in the area at the downstream toe of the dam. Most of the trees on the crest are leaning over the lake, to the extent that they may fall over into the lake. The roots of the trees on the crest extend from the upstream edge of the crest to the downstream edge of the crest. The crest of the dam was generally not more than a few inches higher than the level of the water in the lake at the time of the inspection. Near the center of the dam the crest dips slightly and the lake level is at the crest of the embankment. A railroad tie has been placed across this low area, however, water is leaking under the tie and flowing around the ends of the tie. A large tree has been uprooted from the crest near the right abutment and its root ball has been pulled out, leaving a large hole in the crest. Also near the west abutment there is a stump of a large tree that has been cut. Very severe erosion has taken place on the upstream slope at the waterline. The vertical profile of the crest is very uneven.

b. Appurtenant Structures. The dry stone masonry which retains the downstream slope of the dam in the vicinity of the low-level outlet at the east end of the dam bulges downstream. The lowest of the two outlet pipes is partially buried in sediment. No operating mechanism could be located for either pipe. However, according to a letter from Mrs. A.M. Sabety dated 12/12/79: "the overflow valve for the lake is located at waters edge on my property and is regulated by the town at its pleasure. The valve is embedded in the dam and empties into the water fall and brook that flows through the wooded area". Public Works Supt. Carl Danser, present during the visual inspection, was not aware of any regulating valves.

The outlet pipe at the emergency spillway is weathered and has a chunk broken from the top of the pipe, and the mortared masonry at the downstream toe of the spillway is broken and undermined. The surface of the concrete spillway is eroded to a minor degree exposing the coarse aggregate.

c. Reservoir Area. The watershed above the lake is gently to moderately sloping and wooded. There are several homes on the shore of the lake. Slopes on the shore of the lake appear stable. No evidence of significant sedimentation in the lake was observed.

d. Downstream Channel. Some brush is growing on the banks of the poorly defined channel downstream of the low-level pipes at the east end of the dam. A few trees are growing on the banks of the channel downstream of the emergency spillway at the east end of the lake.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures are in effect.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam are followed.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were obtained.

4.4 Warning System

No description of any warning system was found.

4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures, the reservoir measures described in Section 7.2 should be implemented as prescribed.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. No hydrologic or hydraulic design data could be found.

b. Experience Data. No experience data were revealed.

c. Visual Observation. The crest of the dam was generally not more than a few inches higher than the level of the lake at the time of inspection. Near the center of the dam the lake level was at the crest of the embankment and a railroad tie had been placed across the low area. However, water was seeping under and around the ends of the tie. Two low-level outlet pipes located at the east end of the dam were not operable. The upstream face of the dam was silted so the inlet to outlet pipes could not be located. The lower pipe was partially buried in sediment. A small rust colored seepage was discharging from the lower pipe. The area at the downstream toe of the dam was generally wet and soft and some seepage water was discharging. At the time of inspection about 1 inch of water was flowing over the crest of the emergency spillway. The inlet to the low-level outlet pipe of the emergency spillway was buried in debris and sediment. A metal post and submerged chain on the upstream face of the spillway indicated the existence of some type of regulating facilities.

d. Overtopping Potential. The hydraulic/hydrologic evaluation for Sunset Lake Dam is based on a Spillway Design Flood (SDF) equal to one-half the Probable Maximum Flood (PMF) in accordance with the range of test floods given in the evaluation guidelines for dams classified as significant and small in size. The PMF has been determined by application of the SCS Dimensionless Unit Hydrograph Procedure to a 6-hour probable maximum storm of 25.5 inches. The inflow hydrograph from the immediate drainage area was added to outflow from Crystal Lake Dam, NJ00169, to develop the inflow hydrograph. Hydrologic computations are given in Appendix 3. The routed half-PMF peak discharge for the subject watershed is 362 cfs.

The minimum elevation of the dam allows .1 foot of depth above the emergency spillway before overtopping begins. Under this head the emergency spillway capacity is estimated to be .8 cfs.

Routing calculations indicate that Sunset Lake Dam will be overtopped for 7 hours to a maximum depth of 1.05 foot under half-PMF conditions. It is estimated that the emergency spillway can pass less than 1% of the PMF without overtopping the dam; thus the spillway is considered inadequate. Because the dam is classified as significant hazard, the increase in downstream hazard due to overtopping failure was not specifically assessed. It is clear that a breach would cause extensive property damage to homes lying immediately downstream of the dam, along the south side of East Shore Road.

SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

An extensive soft, wet area and seepage at the downstream toe of the dam are indicative of seepage through and under the dam which, if not properly controlled, could lead to failure of the dam by piping or sloughing of the downstream slope. Trees growing on the crest of the dam may blow over and pull out their roots and this could lead to breaching of the dam because the crest is only a few inches above the lake level. One tree has already blown over, leaving a hole in the crest where its roots pulled out, and this hole weakens the crest. If a tree dies and its roots rot, seepage and erosion may take place along the root channels. The center of the dam is below lake level and leakage around the ends and beneath the railroad tie that has been placed at the center to impede the flow of water over the crest could cause erosion of the crest and breaching of the dam at any time. Erosion of the upstream slope at the waterline will eventually lead to breaching of the dam if it is not controlled.

6.2 Design and Construction Data. No design or construction data pertinent to the structural stability of the dam were available.

6.3 Operating Records. No operating records pertinent to the structural stability of the dam were available.

6.4 Post-Construction Changes. No records of post-construction changes were available.

6.5 Seismic Stability. This dam is in Seismic Zone 1. According to the Recommended Guidelines, dams located in Seismic Zone 1 "may be assumed to present no hazard from earthquake provided static stability conditions are satisfactory and conventional safety margins exist". None of the visual observations made during the inspection are indicative of unstable slopes. However, because no data are available concerning the engineering properties of the embankment and foundation materials for this dam, it is not possible to make an engineering evaluation of the stability of the slopes or the factor of safety under static conditions.

SECTION 7
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Sunset Lake Dam is 65 years old and in very poor condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based on the results of the visual inspection.

c. Urgency. The recommendations made in 7.2 a. and 7.2 b. should be implemented by the owner as prescribed.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems which are listed in 7.2 a. These problems require the attention of a professional engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problem. If left unattended, the problems could lead to failure of the dam.

7.2 Recommendations/Remedial Measures

a. Recommendations. The owner should immediately engage a professional engineer qualified in the design and construction of dams to design a complete rehabilitation or replacement of the existing dam, including the following:

1. Repair or replacement of the low-level outlet valve.
2. Investigation of the cause of the seepage and wet, soft areas at the downstream toe of the dam.
3. Removal of the trees from the entire embankment.
4. Provision of adequate freeboard, topwidth and slope protection to prevent overtopping by high water and wave action.
5. Repair or replacement of the dry stone masonry wall that retains the downstream slope of the embankment in the vicinity of the low-level outlet pipes at the left abutment.
6. Reassessment of the hydrologic and hydraulic characteristics of the watershed and reservoir so that adequate spillway capacity is provided in the rehabilitated structure.

b. Operating and Maintenance Procedures. The owner should do the following immediately:

1. Lower the water level in the lake until remedial measures can be effected.

2. Check the condition of the dam regularly and monitor the wet area at the downstream toe until repairs, rehabilitation, or replacement are completed.

3. Establish a surveillance program for use during and immediately following periods of heavy rainfall and also a warning program to follow in case of emergency conditions.

The owner should do the following soon:

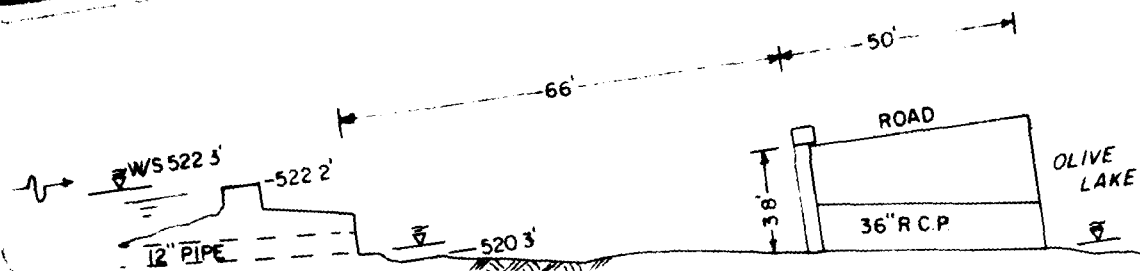
1. Remove trees and brush for a distance of 25 feet downstream of the dam, and from a zone 25 feet wide on either side of the discharge channel for a distance of at least 50 feet downstream of the dam or to the nearest property line, whichever is closer.

2. Remove trees growing on the banks of the discharge channel downstream of the spillway at the east end of the lake.

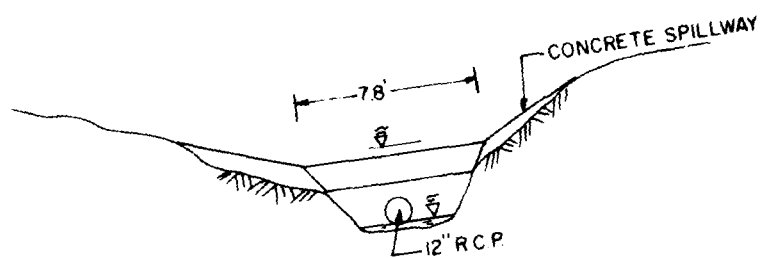
3. Remove debris from the spillway approach channel.

4. Operate the low-level outlet gate to insure proper operation and flush debris out of the pipe.

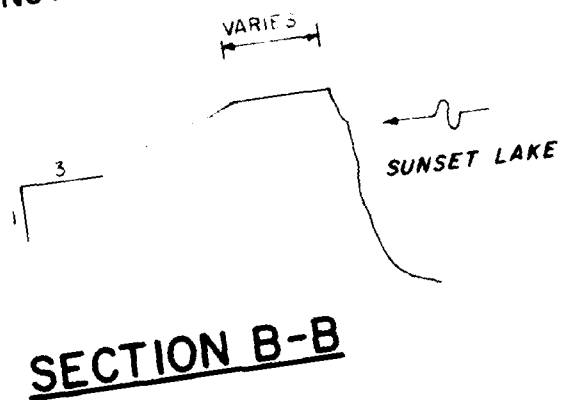
Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.



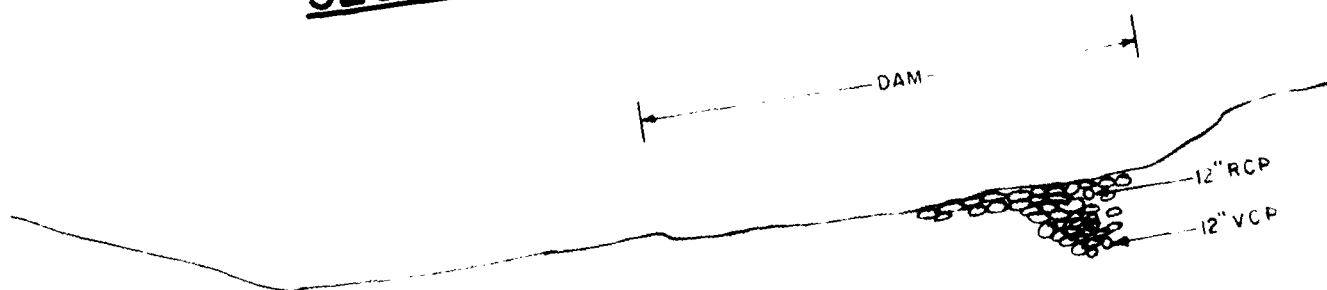
SECTION C-C
(EMERGENCY SPILLWAY)



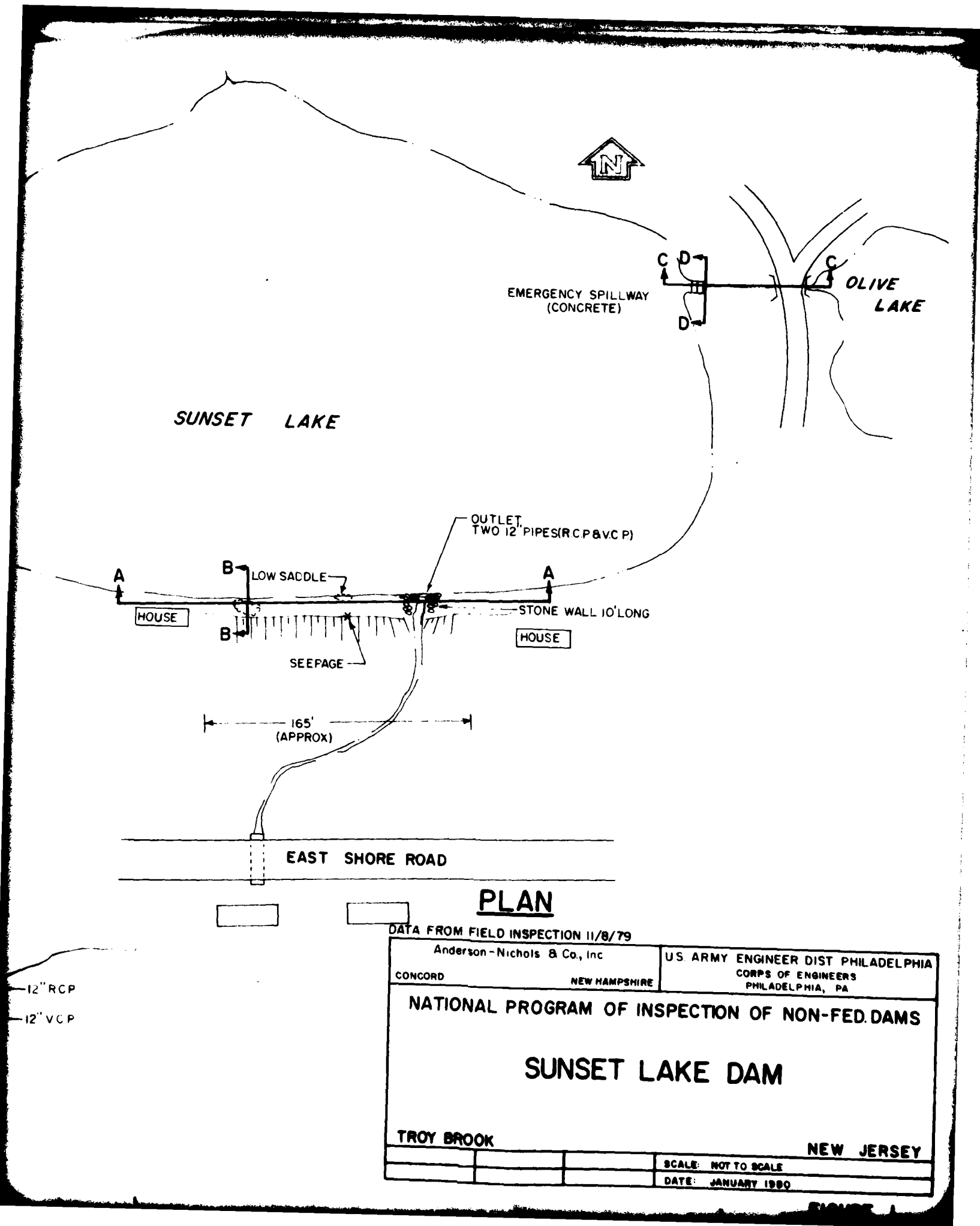
SECTION D-D
(EMERGENCY SPILLWAY)

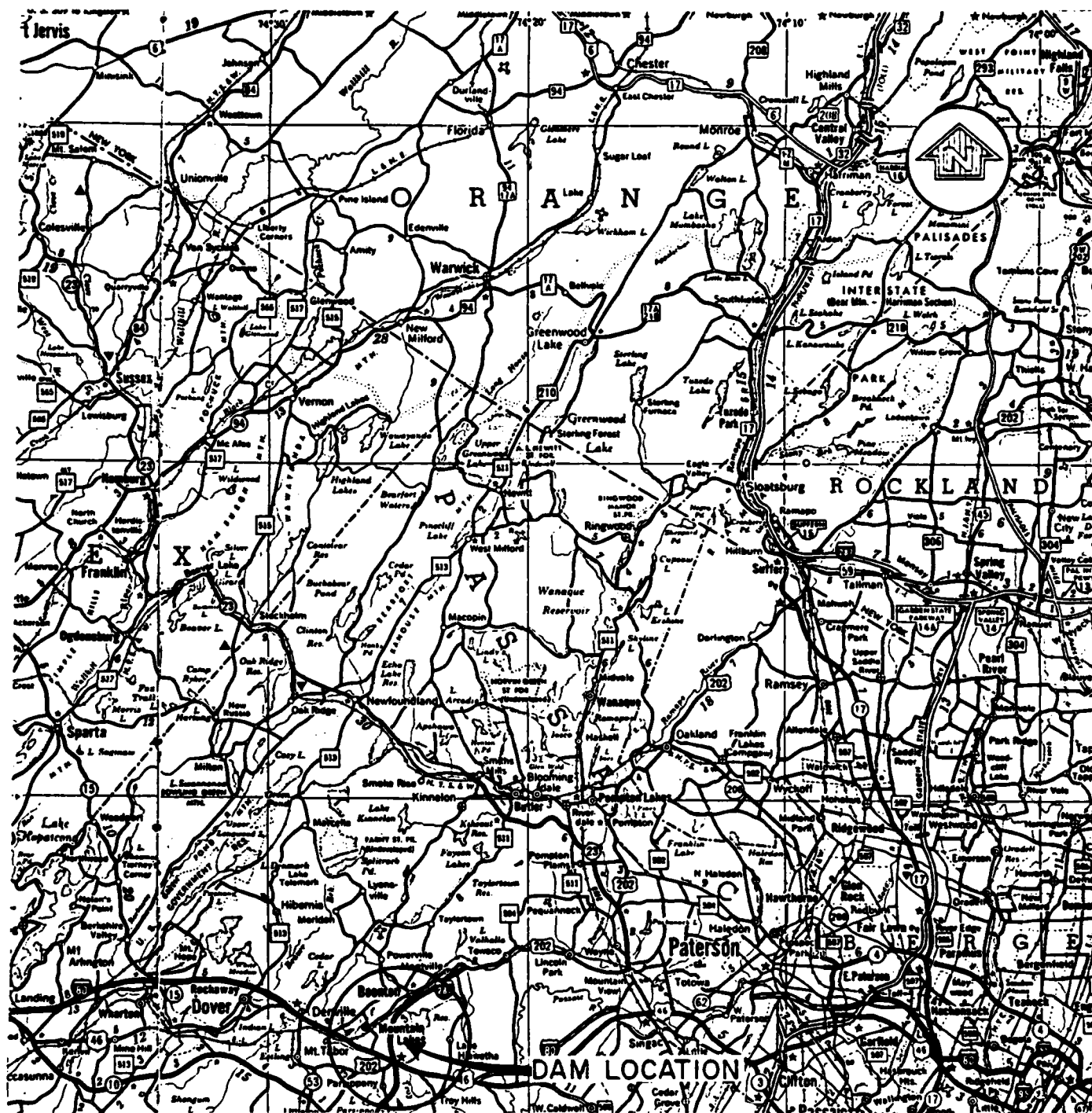


SECTION B-B

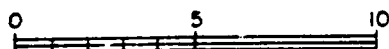


ELEVATION A-A





SCALE IN MILES



MAP BASED ON STATE OF NEW JERSEY
OFFICIAL HIGHWAY MAP AND GUIDE.

Anderson-Nichols & Co., Inc.		U.S. ARMY ENGINEER DIST. PHILADELPHIA	
CONCORD		CORPS OF ENGINEERS	
NEW HAMPSHIRE		PHILADELPHIA, PA.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
<h2 style="text-align: center;">SUNSET LAKE DAM LOCATION MAP</h2>			
TROY BROOK		NEW JERSEY	
		SCALE: SEE BAR SCALE	
		DATE: JANUARY 1980	

APPENDIX 1

CHECKLIST
VISUAL INSPECTION

SUNSET LAKE DAM

Check List
Visual Inspection
Phase 1

Name Dam Sunset Lake County Morris State N.J. Coordinators NJDEP

Date(s) Inspection Nov. 8, 1979 Weather mild, cloudy Temperature 60°F

Pool Elevation at Time of Inspection 522.3 ft. NGVD Tailwater at Time of Inspection 514.8 ft. NGVD

Inspection Personnel:

<u>Warren Guinan</u>	<u>Ronald Hirschfeld</u>
<u>Stephen Gilman</u>	<u></u>
<u>Janusz Czyzowski</u>	<u></u>

Gilman/Hirschfeld Recorder

Carl Danser, Superintendent of Public Works, Borough of Mountain Lakes, was present during the inspection.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Very severe erosion of upstream slope at waterline.	The dam is in need of major rehabili- tation or replacement which should include upstream slope protection.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical alignment is very uneven. Horizontal alignment is fair.	The dam is in need of major rehabili- tation or replacement.
RIPRAP FAILURES	No riprap.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

RAILINGS

No railings.

JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM

Large uprooted tree near
right abutment.The dam is in need of major rehabilitation
or replacement.

ANY NOTICEABLE SEEPAGE

Area downstream of toe of dam is
generally soft and wet.The dam is in need of major rehabilitation
or replacement.

STAFF GAGE AND RECORDER

None observed.

DRAINS

None observed.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Surface of concrete eroded exposing coarse aggregate. No indication of movement.	Repair undermining at the downstream toe of spillway.
AT EMERGENCY SPILLWAY	Outlet pipe-weathered surface, chipped at top mortared masonry at D/S toe of spillway is broken and undermined.	

APPROACH CHANNEL

DISCHARGE CHANNEL

BRIDGE AND PIERS OVER SPILLWAY None.

SUNSET LAKE 'M, NJ

OUTLET WORKS AT UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT		
INTAKE STRUCTURE		
OUTLET PIPE	Weathered concrete pipe with top of pipe chipped.	
OUTLET CHANNEL	Trees and brush overhang channel.	
EMERGENCY GATE	Not visible below water surface.	

SUNSET LAKE DAM, NJ

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	None observed.	
PIEZOMETERS	None observed.	
OTHER	None observed.	

SUNSET LAKE W, NJ

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gently sloping. Many houses on shore.	
SEDIMENTATION	No evidence of significant sedimentation observed.	

SUNSET LAKE DAM, NJ

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Poorly defined, overgrown with trees and brush.	
SLOPES	Moderately sloping, immediately downstream of dam. Further downstream area is broad and flat.	
APPROXIMATE NO. OF HOMES AND POPULATION	3 houses across the street, 250 feet downstream of the dam. Estimated population of 12 people.	A breach could cause inundation of up to 2 feet. Because area is flat, low velocities would be expected.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	No original plans were disclosed, plans for this report were developed from visual inspection.
REGIONAL VICINITY MAP	Prepared for this report.
CONSTRUCTION HISTORY	None found.
TYPICAL SECTIONS OF DAM	Prepared for this report from visual inspection.
HYDROLOGIC/HYDRAULIC DATA	None available.
OUTLETS - PLAN	None found.
- DETAILS	None found.
- CONSTRAINTS	None found.
- DISCHARGE RATINGS	None found.
RAINFALL/RESERVOIR RECORDS	None found.

ITEM	REMARKS
DESIGN REPORTS	None found.
GEOLOGY REPORTS	None found.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None found.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None found.
POST-CONSTRUCTION SURVEYS OF DAM	None found.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SERVICES	Unknown.
MODIFICATIONS	None found.
HIGH POOL RECORDS	None found.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None found.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None found.
MAINTENANCE OPERATION RECORDS	None found.

ITEM	REMARKS
SPILLWAY PLAN	No original plans were found.
SECTIONS	Cross section for this report was prepared from visual inspection.
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	None.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: .37 square mile, hilly, wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 522.3 ft. NGVD (74 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not applicable

ELEVATION MAXIMUM DESIGN POOL: ($\frac{1}{2}$ PMF) - 523.4 ft. NGVD

ELEVATION TOP DAM: 522.3 ft. NGVD

CREST: Emergency spillway

- a. Elevation 522.2 ft. NGVD
- b. Type Concrete step
- c. Width 1.0 foot
- d. Length 7.8 ft.
- e. Location Spillover East end of the lake
- f. Number and Type of Gates None

OUTLET WORKS: At the main dam - not operable

- a. Type Two 12-inch diameter RCP & VCP pipes
- b. Location East end of the dam
- c. Entrance Inverts Unknown
- d. Exit Inverts 518.8 ft. NGVD and 514.8 ft. NGVD
- e. Emergency Draindown Facilities

HYDROMETEOROLOGICAL GAGES: None

- a. Type
- b. Location
- c. Records

MAXIMUM NON-DAMAGING DISCHARGE: .8 cfs (low-level outlets not operating)

APPENDIX 2

PHOTOGRAPHS

SUNSET LAKE DAM



NOV 08 1979

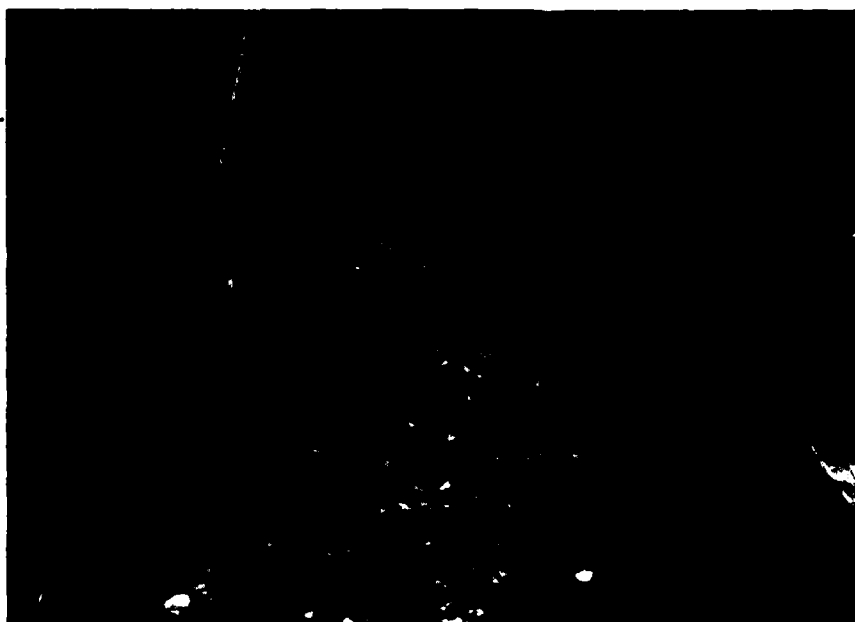
Crest of the dam looking east from
west abutment.



NOV 08 1979

Crest of the dam looking west from
east abutment.

Sunset Lake Dam



NOV 08 1979

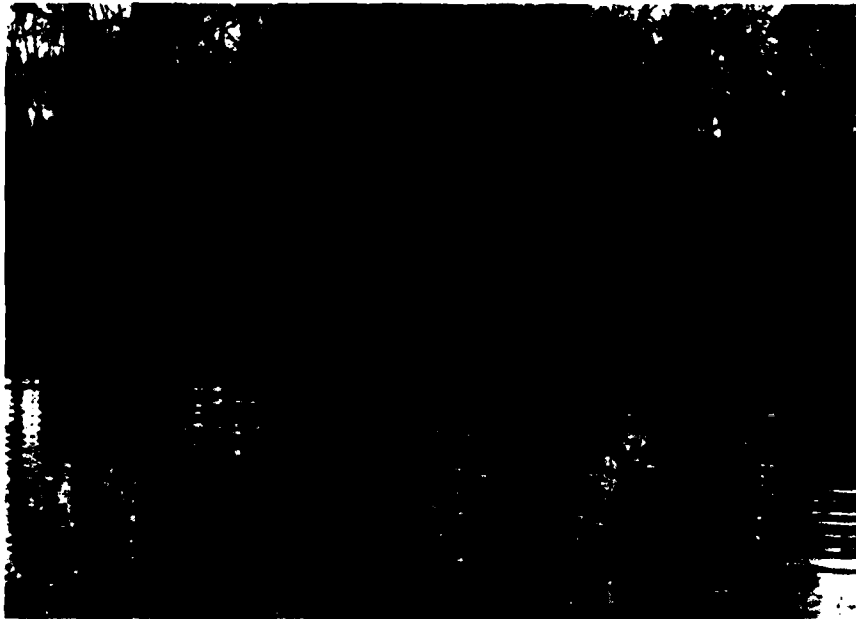
View of a railroad tie placed across
low area at the center of the dam.



NOV 08 1979

Two outlet pipes located at the east
end of the dam.

Sunset Lake Dam



NOV 08 1979

Upstream face of the dam from easterly
shoreline.



NOV 08 1979

Downstream face of the dam near
west abutment

Sunset Lake Dam



NOV 08 1979

Looking at the downstream channel below low-level outlets at the east end of dam. (Discharge is from seepage)



NOV 08 1979

View from the top of the dam looking south.
Houses are located in hazard area.

Sunset Lake Dam



NOV 08 1979

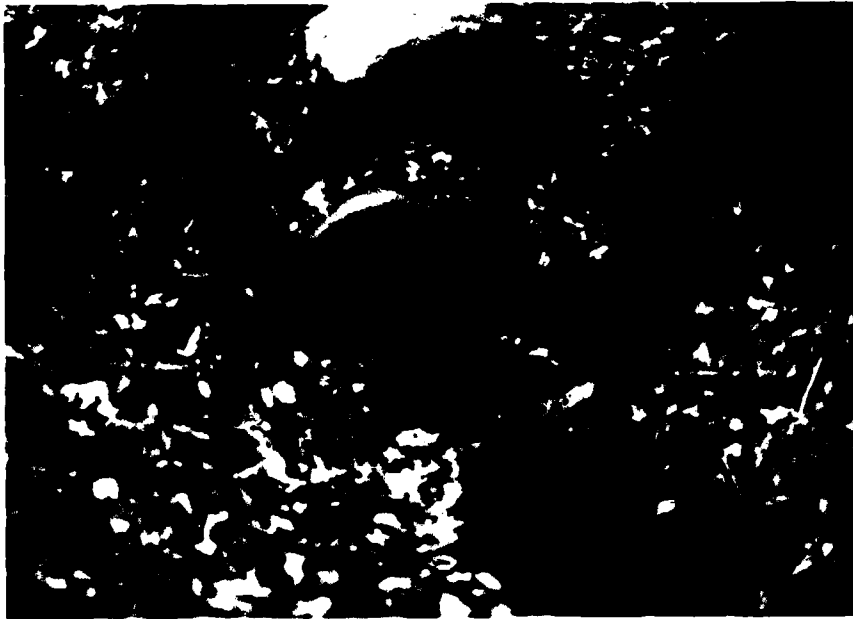
Seepage and uprooted stump located 40 feet
downstream of the dam.



NOV 08 1979

House located at the east abutment of the dam.

Sunset Lake Dam



NOV 08 1979

Culvert beneath east shore road located approx.
200 feet downstream of dam.



NOV 08 1979

View of the reservoir from the crest of the
emergency spillway.

Sunset Lake Dam



NOV 08 1979
Emergency spillway at the east end of the lake.

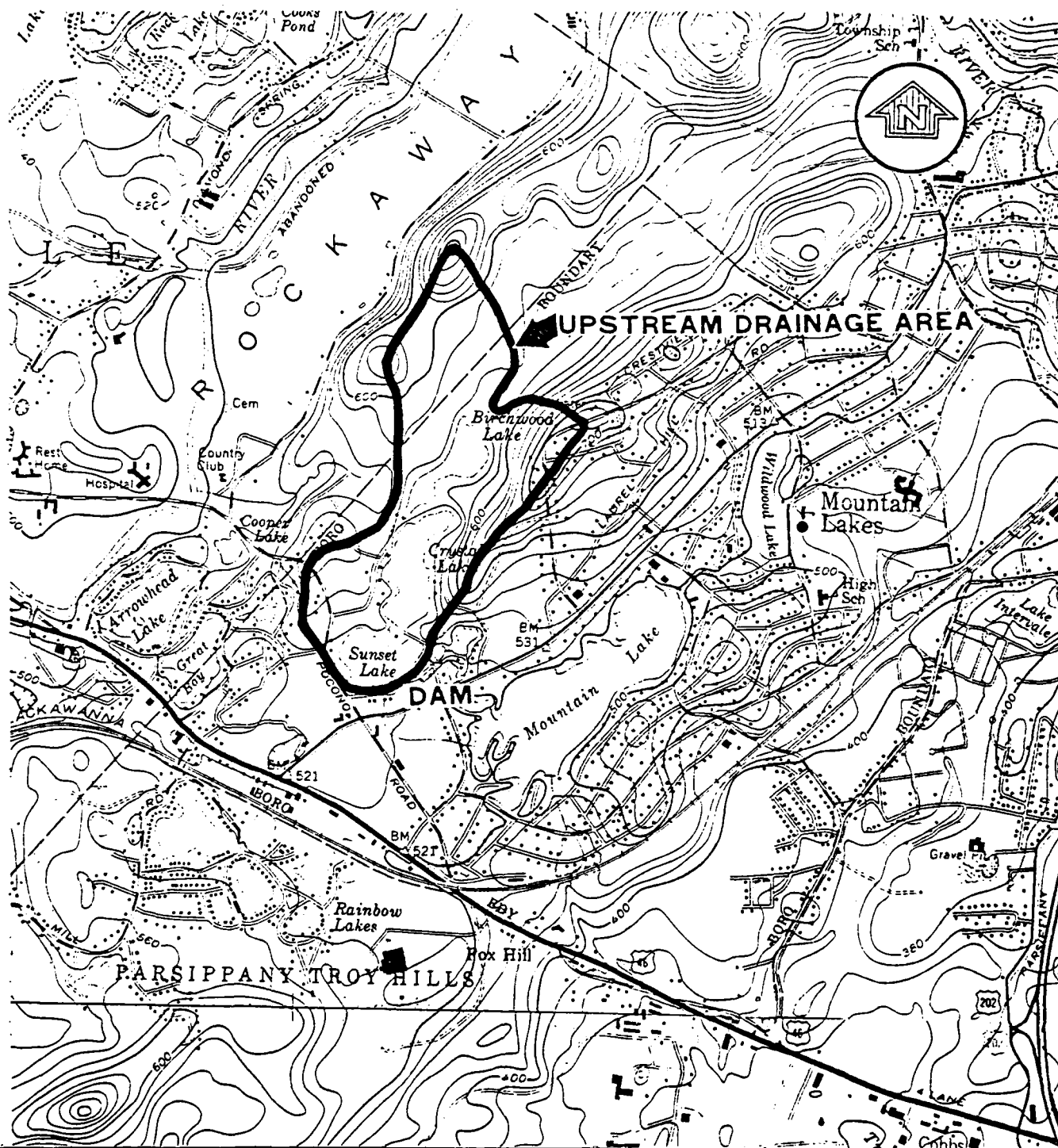


NOV 08 1979
Looking downstream from the emergency spillway.

Sunset Lake Dam

APPENDIX 3
HYDROLOGIC COMPUTATIONS

SUNSET LAKE DAM



NATIONAL PROGRAM OF INSPECTION OF
NON-FED. DAMS

SUNSET LAKE DAM

BOROUGH OF MOUNTAIN LAKES, NEW JERSEY

REGIONAL VICINITY MAP

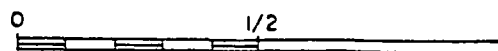
JANUARY 1980

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

ANDERSON-NICHOLS & CO., INC.

BOSTON, MA

SCALE IN MILES



MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE
SHEETS. BOONTON, N.J., 1954, UPDATED 1970.
MORRISTOWN, N.J., 1954, UPDATED 1970.

Anderson-Nichols & Company, Inc.

Subject H S H

Sheet No. 1 of 10
Date 11/19/77
Computed JD
Checked DD

JOB NO. 3409-07

QUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
1/4 IN. SCALE

SUNSET LAKE DAM

HYDROLOGIC / HYDRAULIC COMPUTATIONS

LOCATION - MORRIS COUNTY, N.J.

DRAINAGE AREA - .37 SQUARE MILE

EVALUATION CRITERIA - SIZE : SMALL

HAZARD : SIGNIFICANT

APPROACH : TO DEVELOP INFLOW HYDROGRAPH
FOR SUNSET LAKE THE OUTFLOW FROM CRYSTAL
LAKE DAM WAS ADDED TO INFLOW HYDROGRAPH
FROM THE INTERMEDIATE DRAINAGE AREA.

JOB NO. 3409 - 07

SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

SUNSET LAKE DAM - COMPUTATION OF TIME
OF CONCENTRATION

ONLY
INTERMEDIATE DRAINAGE AREA - .08 SQUARE MILE
OVERLAND FROM ONLY: LENGTH $L = 1200$ FT
AVERAGE SLOPE $S = .050$

1. THE TEXAS HIGHWAY VELOCITY DATA FROM DESIGN OF SMALL DAMS $S = 5\%$, WOODLAND $\rightarrow 2.0$ FT/SEC

$$\frac{1200 \text{ FT}}{2.0 \text{ FT/SEC}} = .17$$

2. THE SCS TR-55 - NATION "STORM WATER MANAGEMENT"

AVERAGE VELOCITY FOR WOODLAND $\rightarrow .6$ FT/SEC

$$T_c = \frac{1200 \text{ FT}}{3600 \cdot .6 \text{ FT/SEC}} = .55 \text{ hr.}$$

3. METHOD FROM SOIL AND WATER CONSERVATION ENG.

$$Y = 5\% \text{ (SLOPE)} \quad S = \frac{1000}{N} - 10$$

$$N = 70 \text{ FOR WOODS}$$

$$S = 4.3$$

$$.6 T_c = \frac{L^{.8} (S+1)^{1.49}}{9000 Y^{.8}} = .23$$

$$T_c = .39 \text{ hr.}$$

4. KIRBY METHOD IN "WORKSHOP NOTES ON STORM SEWER SYSTEM DESIGN."

$$T_c = .83 \left(\frac{NL}{K} \right)^{.467}$$

$$= .83 \left(\frac{.6 \cdot 1200}{1.49} \right)^{.467} = 36 \text{ MIN} = .60 \text{ hr.}$$

$$N = .60 \text{ FOR TIGERLAND}$$

Anderson-Nichols & Company, Inc.

Subject HCH

Sheet No. 3 of 10

Date 11/20/79

Computed 9/2

Checked F20

JOB NO. 3409 - 07

SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

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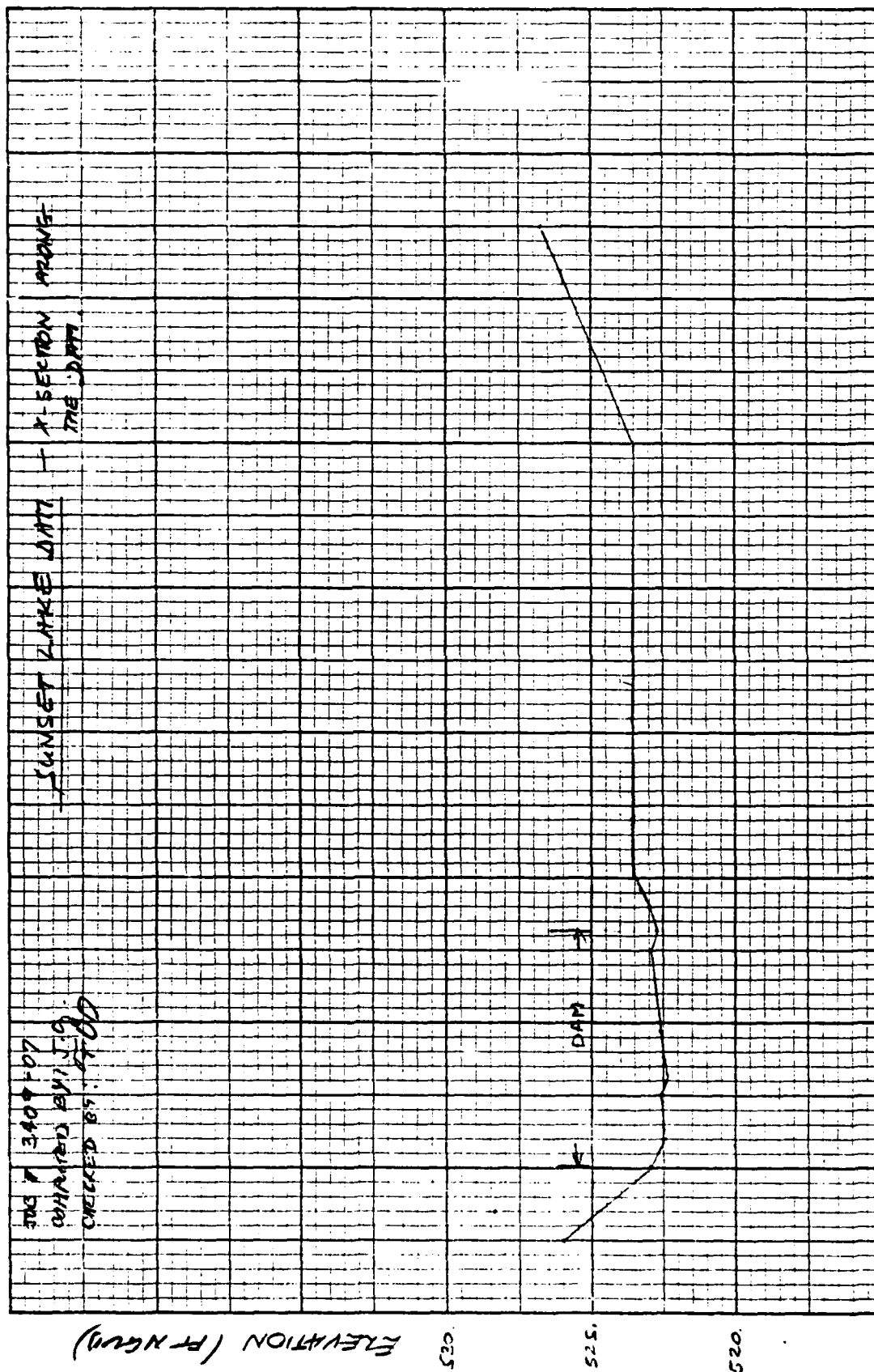
SUNSET LAKE DAM - COMPUTATION OF
TIME OF CONCENTRATION
CONT'D

AVERAGE TIME OF CONCENTRATION

$$\frac{.17 + .55 + .39 + .60}{4} = .43 \text{ hr} = T_c$$

FOR INTERMEDIATE DRAINAGE
AREA ONLY

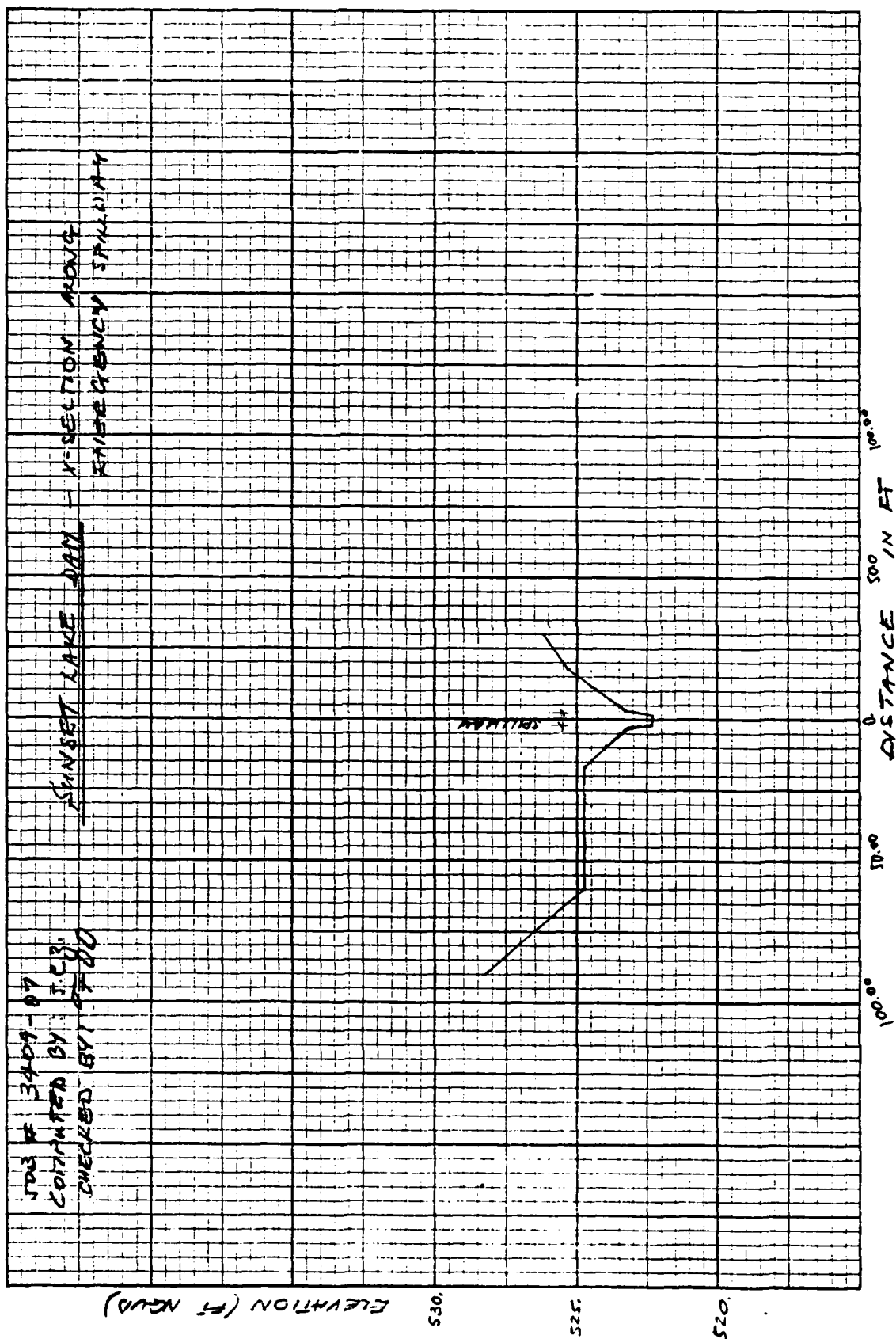
NO. 31.282. 10 DIVISIONS PER INCH BOTH WAYS. 60 BY 90 DIVISIONS.
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 codex®
 GRAPH PAPER



D/S.W.

NO. 31.292. 10 DIVISIONS PER INCH BOTH WAYS. 60 BY 90 DIVISIONS.
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codex
 GRAPH PAPER



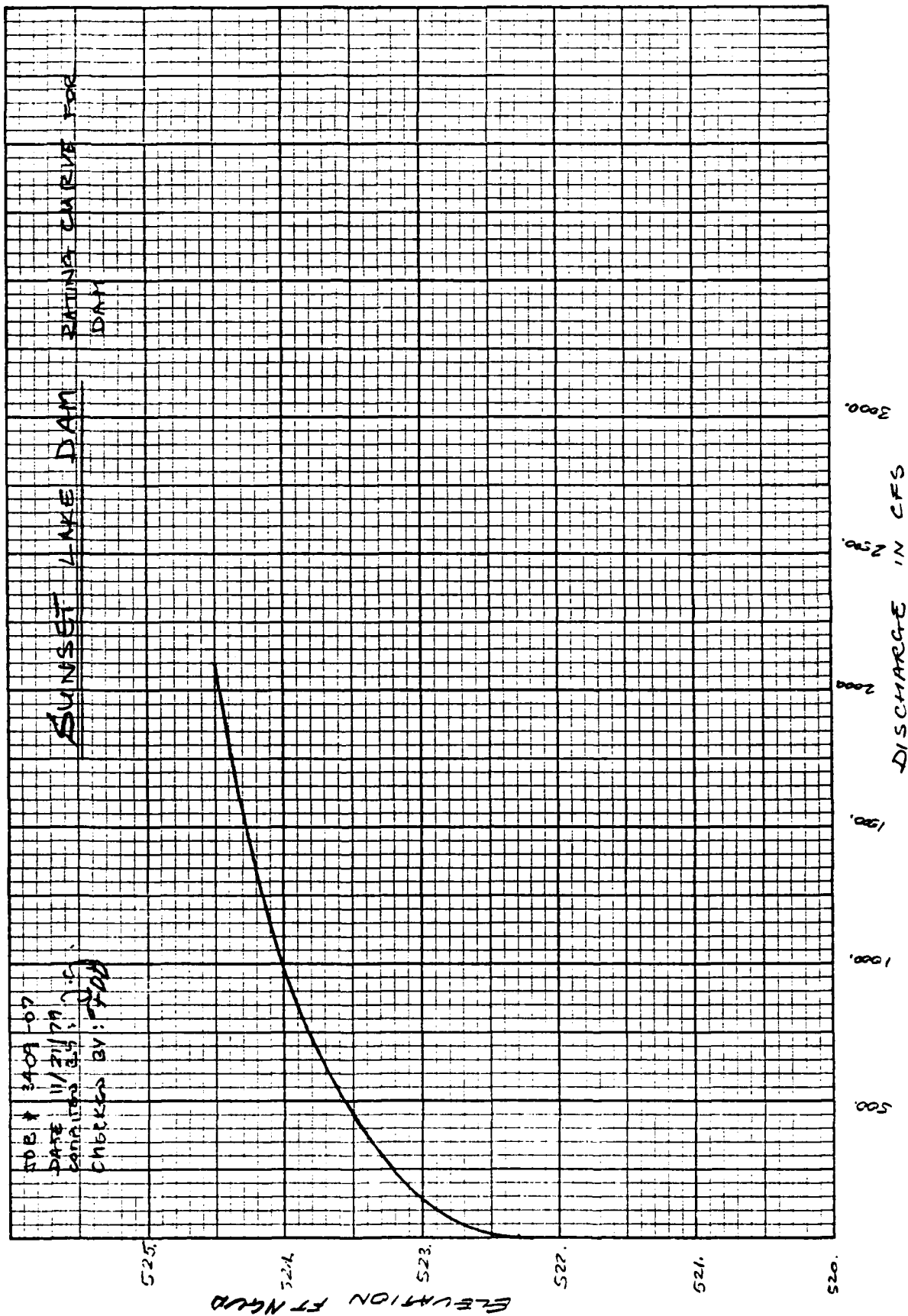
JOB NO. 3409-07 SUNSET LAKE DAM

SQUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
 1/4 IN. SCALE

RATING CURVE - SUNSET LAKE DAM & EMERGENCY SPILLWAY
Q = CCH^{3/2}

ELEVATION (FT. NGVD)	DAM				EMERGENCY SPILLWAY				TOTAL STRUCTURE
	H	L	Q	Q	H	L	Q	Q	
522.2	0	0	0	0	0	0	0	0	0
522.3	0	0	0	0	.1	7.8	.8	.8	.8
522.5	.2	10	2.2	2.2	.3	7.8	4.1	4.1	4.3
523.0	.7	80	117	117	.8	7.8	25	25	142
523.5	1.2	120	394	416	1.3	7.8	37	37	453
524.0	1.7	130	700	903	1.8	7.8	60	64	967
524.5	2.2	140	1140	1990	2.3	7.8	87	105	2095
525.0	2.7	150	1660	2340	2.8	7.8	117	163	2503

C = 2.5
 C = 3.2
 C = 2.5



JOB NO. 3409-07

SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

SUNSET LAKE DAM - STORAGE COMPUTATION

NORMAL STORAGE (SPILLWAY CREST - 522.2 FTMSL) - 73.5 AC-FT

73.5 AC-FT WAS OBTAINED BY ESTIMATING AVERAGE
DEPTH OF RESERVOIR 2.5 FT AND PLANIMETERING SURFACE
OF RESERVOIR FROM QUAD SHEET - 14.7 AC

USING 'FRUSTUM OF PYRAMID EQUATION' AND
PLANIMETERED SURFACE AREAS STORAGE-ELEVATION
RELATIONSHIP WAS DEVELOP

$$\Delta V = \frac{1}{3} h (b_1 + b_2 + \sqrt{b_1 b_2})$$

h - ELEV. ABOVE NORMAL POOL

b₁ - NORMAL POOL SURFACEb₂ - ENLARGE POOL - 5 -

ELEV. (FT NGVD)	b ₁ (AC)	b ₂ (AC)	h (FT)	ΔV (AC-FT)	TOTAL V (AC-FT)
522.2	14.7				73.5
522.3	14.7	14.7	.1	.5	74.
524.	14.7	17.5	1.8	29.	103.

Anderson-Nichols & Company, Inc.

Subject H²H

Sheet No. 9 of 10
Date 12-26-79
Computed J.G.
Checked FDD J

JOB NO. 3409-07

SUNSET LAKE DAM

SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

STORAGE - ELEVATION CURVE

STORAGE
(AC-FT)

120.

80.

40.

520.

521.

522.

523.

524.

ELEV.
(FT. NGVD)

Anderson-Nichols & Company, Inc.

Subject HS 4

Sheet No. 10 of 10
 Date 12-26-79
 Computed J S
 Checked FDD

JOB NO. 3409-07

SUNSET LAKE DAM

SQUARES
1/4 IN SCALE

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33
34
35
36
37
38

% PMF ↑

50.

40.

30.

20.

10.

100

200

300

400

OUTFLOW
(CFS)

DAM OVERTOPS AT APPROX. ELEVATION 522.3 FT NGVD
 WITH $Q = 1.0$ CFS

∴ SPILLWAY CAN PASS ~ .1 % of PMF

HEC-1 OUTPUT

SUNSET LAKE DAM

ALJUD 3409-07 SUBJECT LAKE CAR ROROUGH OF MOUNTAIN LAKES, A. J. NJH25-121 US#563
TOXICOLOGICAL ANALYSIS ARNOLDSON-NICHOLS & CO. INC. CORPORD, N. H.

LABOR 3409-07 SURESET LAKE CAMP ROUGH OF MOUNTAIN LAKES, I. J. NJ#25-121 U#56.3
SCOPOTOPHINE ANALYSIS ARNOLD-NICHOLS & CO. INC. CONCORD, N.H.
3401, 0.05, AND 0.5 MULTIPLE OF THE FROM A HOUR PM

EXCUTELON HYDROGRAPH FROM LIFCWOOD LAKE USE TO COMPUT J1 MULTIPLES OF RPF

DEVELOP INFLOW HYDROGRAPH FOR INTERPRETATION CRAINAGE AREA FOR CRYSTAL LAKE

[illegible]

• 00-000000 • 1111
• 00/00/00 • 1111

JOB SPECIFICATION									
NO	NPR	APIN	IDAY	IPR	IPIN	METRC	IPLT	IPRT	INSTAN
90	0	5	0	0	0	0	0	0	0
			JOPER	NWT	LROFT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED

MPPLAN= 3 NRTIO= 3 LRTIO= 1

Time	0.10	0.25
Time	0.10	0.25

SUP-AREA RUNOFF COMPUTATION

OUTFLOW HYDROGRAPH FROM BIRCHWOOD LAKE USE TO COMPUTE .1 MULTIPLE OF PMF

IS'PO	ICOMP	IECON	ITAFF	JFLT	JOPT	INAME	ISTAGE	IAUTC
0	0	0	0	0	1	1	0	0

HYDROGRAPH DATA

[illegible]

HYDROGRAPH AT STA A1 FOR PLATE 1, ETIC 1

[illegible]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	6.	4.	4.	4.		327.
CFS	0.	0.	0.	0.		0.
TPCFS		.21	.21	.21		.21
TP		5.26	5.37	5.37		5.37
AC-ST		2.	2.	2.		2.
THOUS CH D		3.	3.	3.		3.

HYDROGRAPH AT STA A1 FOR PLAN 2, RTIC 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
0.	22.	0.	0.	0.	481.
1.	1.	0.	0.	0.	14.
2.	0.	30.	31.	31.	31.
3.	0.	7.61	7.61	7.61	7.61
4.	0.	3.	3.	3.	3.
5.	0.	4.	4.	4.	4.
6.	0.	0.	0.	0.	0.
7.	0.	0.	0.	0.	0.
8.	0.	0.	0.	0.	0.
9.	0.	0.	0.	0.	0.
10.	0.	0.	0.	0.	0.
11.	0.	0.	0.	0.	0.
12.	0.	0.	0.	0.	0.

CFS
CFS
INCHES
AC-FT
THOUS CU F

HYDROGRAPH AT STA A1 FOR PLAN 3, RTIC 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
0.	190.	20.	16.	16.	1962.
1.	5.	1.	0.	0.	41.
2.	0.	.93	.93	.93	.93
3.	0.	23.50	23.50	23.50	23.50
4.	0.	10.	10.	10.	10.
5.	0.	12.	12.	12.	12.
6.	0.	0.	0.	0.	0.
7.	0.	0.	0.	0.	0.
8.	0.	0.	0.	0.	0.
9.	0.	0.	0.	0.	0.
10.	0.	0.	0.	0.	0.
11.	0.	0.	0.	0.	0.
12.	0.	0.	0.	0.	0.

CFS
CFS
INCHES
AC-FT
THOUS CU F

SUF-APFA RUNOFF COMPUTATION

DEVELOP INFLOW HYDROGRAPH FOR INTERPRETIVE DRAINAGE AREA FOR CRYSTAL LAKE

ISTAQ 12.00 ICDP 0.00 ITAPE 0.00 JFLT 0.00 JNAP 1.00 JNAP 1.00 JNAP 1.00

HYDROGRAPH DATA
 IUNG 2 IUNG 2 IUNG 2 IUNG 2 IUNG 2 IUNG 2 IUNG 2 IUNG 2 IUNG 2 IUNG 2
 SNAP 0.00 SNAP 0.00 SNAP 0.00 SNAP 0.00 SNAP 0.00 SNAP 0.00 SNAP 0.00 SNAP 0.00 SNAP 0.00 SNAP 0.00
 TRSDA 0.00 TRSDA 0.00 TRSDA 0.00 TRSDA 0.00 TRSDA 0.00 TRSDA 0.00 TRSDA 0.00 TRSDA 0.00 TRSDA 0.00 TRSDA 0.00
 RATIO 0.000 RATIO 0.000 RATIO 0.000 RATIO 0.000 RATIO 0.000 RATIO 0.000 RATIO 0.000 RATIO 0.000 RATIO 0.000 RATIO 0.000
 ISNOW 0 ISNOW 0 ISNOW 0 ISNOW 0 ISNOW 0 ISNOW 0 ISNOW 0 ISNOW 0 ISNOW 0 ISNOW 0
 ISNPE 1 ISNPE 1 ISNPE 1 ISNPE 1 ISNPE 1 ISNPE 1 ISNPE 1 ISNPE 1 ISNPE 1 ISNPE 1
 LOCAL 0 LOCAL 0 LOCAL 0 LOCAL 0 LOCAL 0 LOCAL 0 LOCAL 0 LOCAL 0 LOCAL 0 LOCAL 0

PRECIP DATA

NP	STORM	DAJ	OAK
72	0.00	0.00	0.00
21	.21	.21	.21
26	.26	.26	.26
32	.32	.32	.32
39	.39	.39	.39
30	.30	.30	.30
23	.23	.23	.23

LOSS DATA

LEOPT	STKRS	OLINE	RTIOL	FRAIN	STKRS	RTIOL	STIRL	CMSTL	ALSPX	RTIMP
0.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

IC= 0.00 LAG= .13

RECESSION DATA

STRIG= -3.00 GRCSH= 0.00 RTIOR= 1.00

TIME INCREMENT TOO LARGE--(NHO IS GT LAG/2)

UNIT HYDROGRAPH TO END OF PERIOD ORIGINALS, IC= 0.00 HOURS, LAG= .13 VOL= 1.00

FWD-OF-PERIOD FLOW

PC.DA	PR.DA	PERIOD	RAIF	EXCS	LOSS	COMP	PC.DA	HP.PA	PERIOD	RAIN	EYCS	LOSS	COMP
1.01	1.01	1	.17	0.00	.17	0.00	1.01	3.50	46	.46	.46	.01	.575
1.01	1.01	2	.17	0.00	.17	0.00	1.01	3.50	47	.46	.30	.01	.421
1.01	1.01	3	.17	0.00	.17	0.00	1.01	4.00	48	.31	.30	.01	.316
1.01	1.01	4	.17	0.00	.17	0.00	1.01	4.05	49	.24	.23	.01	.250
1.01	1.01	5	.17	0.00	.17	0.00	1.01	4.10	50	.24	.23	.01	.206
1.01	1.01	6	.17	.02	.15	.30	1.01	4.15	51	.24	.23	.01	.191
1.01	1.01	7	.17	.16	.01	.24	1.01	4.20	52	.24	.23	.01	.165
1.01	1.01	8	.17	.16	.01	.64	1.01	4.20	53	.24	.23	.01	.164
1.01	1.01	9	.17	.16	.01	.91	1.01	4.30	54	.24	.23	.01	.162
1.01	1.01	10	.17	.16	.01	102	1.01	4.30	55	.24	.23	.01	.161
1.01	1.01	11	.17	.16	.01	109	1.01	4.40	56	.24	.23	.01	.161
1.01	1.01	12	.17	.16	.01	111	1.01	4.40	57	.24	.23	.01	.161
1.01	1.01	13	.20	.20	.01	116	1.01	4.50	58	.24	.23	.01	.161
1.01	1.01	14	.20	.20	.01	125	1.01	4.55	59	.24	.23	.01	.161
1.01	1.01	15	.20	.20	.01	132	1.01	5.00	60	.24	.23	.01	.161
1.01	1.01	16	.20	.20	.01	134	1.01	5.05	61	.19	.18	.01	.155
1.01	1.01	17	.20	.20	.01	136	1.01	5.10	62	.19	.18	.01	.142
1.01	1.01	18	.20	.20	.01	136	1.01	5.15	63	.19	.18	.01	.132
1.01	1.01	19	.20	.20	.01	137	1.01	5.20	64	.19	.18	.01	.128
1.01	1.01	20	.20	.20	.01	137	1.01	5.20	65	.19	.18	.01	.126
1.01	1.01	21	.20	.20	.01	137	1.01	5.30	66	.19	.18	.01	.126

HYDROGRAPH AT STA A2 FOR PLAN 2, RTIO 2

0.	0.	0.	0.	1.	16.	27.	26.
27.	29.	21.	33.	26.	34.	34.	34.
34.	34.	34.	30.	39.	41.	43.	43.
43.	43.	43.	43.	47.	40.	44.	43.
67.	102.	183.	239.	146.	105.	62.	51.
65.	42.	41.	40.	40.	40.	40.	40.
50.	35.	33.	32.	31.	31.	31.	31.
31.	26.	15.	7.	3.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
239.	46.	37.	37.	3291.
7.	1.	1.	1.	03.
	4.72	4.72	4.72	4.72
	119.92	120.00	120.00	120.00
	23.	23.	23.	23.
	28.	28.	28.	28.

HYDROGRAPH AT STA A2 FOR PLAN 3, RTIO 3

0.	0.	0.	0.	1.	32.	46.	52.
56.	58.	63.	66.	67.	68.	68.	68.
68.	68.	71.	78.	78.	82.	85.	85.
86.	86.	86.	86.	86.	80.	87.	106.
135.	205.	377.	477.	288.	211.	125.	103.
70.	84.	81.	86.	86.	80.	80.	80.
77.	71.	64.	63.	63.	62.	62.	62.
62.	52.	30.	13.	6.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
477.	91.	77.	73.	6582.
14.	3.	2.	2.	186.
	9.44	9.45	9.45	9.45
	239.85	240.00	240.00	240.00
	45.	45.	45.	45.
	56.	56.	56.	56.

COMBINE HYDROGRAPHS

DEVELOP COMBINE INFLOW HYDROGRAPH FOR CRYSTAL LAKE DAP

STA	ICOMP	ICON	ITAP	JFLT	JFRT	INAME	ISTAGE	IAUTO
A3	2	0	0	0	1	1	0	0
SUM OF 2 HYDROGRAPHS AT								
	0.	0.	0.	0.	2.	6.	9.	10.
11.	12.	13.	14.	14.	15.	15.	15.	15.
16.	16.	16.	16.	16.	18.	20.	20.	20.
0.	0.	0.	0.	0.	0.	10.	20.	20.

[illegible]

PEAK OUTFLOW 1' 4. AT TIME 7.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4.	2.	2.	2.	178.
CFS	0.	0.	0.	0.	5.
INCHES		.08	.08	.08	.08
"M		1.95	2.01	2.01	2.01
AC-FT		1.	1.	1.	1.
THOUS CU M		1.	1.	1.	2.

END-OF-PERIOD HYDROGRAPH ORDINATES

STORAGE			
118.	118.	118.	118.
119.	119.	119.	119.
120.	120.	120.	120.
121.	121.	121.	121.
122.	122.	122.	122.
123.	123.	123.	123.
124.	124.	124.	124.
125.	125.	125.	125.
126.	126.	126.	126.
127.	127.	127.	127.
128.	128.	128.	128.
129.	129.	129.	129.
130.	130.	130.	130.
131.	131.	131.	131.
132.	132.	132.	132.
133.	133.	133.	133.
134.	134.	134.	134.
135.	135.	135.	135.
136.	136.	136.	136.
137.	137.	137.	137.
138.	138.	138.	138.
139.	139.	139.	139.
140.	140.	140.	140.

[illegible]

PEAK OUTFLOW IS 28. AT TIME 6.08 HOURS

	PEAK	6-HOUR	24-4 HOUR	72-HOUR	TOTAL VOLUME
CFS	2R	13	10	10	913
INCHES	1	0	0	0	26
		.40	.41	.41	
WM		10.25	10.73	10.33	10.33
AC-FT		6	6	6	6
THOUS CU F		8	P	8	P

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

.....		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
ELEVATION		535.20		535.10		536.00	
STORAGE		116.		116.		135.	
OUTFLOW		0.		0.		7.	
RATIO OF PMF	MAXIMUM RESERVOIR W.S.-ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	535.70	0.00	129.	4.	0.00	7.50	0.00

PLAN 2

.....	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION		
	535.20	535.10	536.00
	STORAGE	118.	135.
	OUTFLOW	0.	7.

PLAN 3

.....		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
ELEVATION		535.20		535.10		536.00	
STORAGE		118.		116.		135.	
OUTFLOW		0.		0.		7.	
RATIO OF PMF	MAXIMUM RESERVOIR W.S.-ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	536.72	.72	149.	252.	4.17	4.00	0.00

SUR-AREA RUNOFF COMPUTATION
DEVELOP INFLOW HYDROGRAPH FOR INTERMEDIATE DRAINAGE AREA FOR SUNSET LAKE

ISTAO 15 ICOMP 0 IECON 0 ITAPE 0 JPLT 0 JPRI 1 INAME 1 ISAGE 0 IAUTO 0
IUNG 2 IAREA .0A SNAP 0.00 IRSDA .0R .80 RATIO 0.000 LOCAL 0

HYDROGRAPH DATA

PRECIP DATA

NP	STORM	DAJ	OAK
72	0.00	0.00	0.00
PRECIP PATTERN			
.21	.21	.21	.21
.21	.26	.26	.26
.26	.26	.32	.32
.32	.32	.32	.32
.32	.32	.32	.32
.68	1.65	2.71	.58
.30	.30	.30	.30
.23	.23	.23	.23
.23	.23	.23	.23

LOSS DATA

LROPT	STRKR	DLIKR	RTIOL	ERAIN	STRKS	RTIOK	SIRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAGE= .25

RECESSION DATA

SIRTO= -3.00 GRCSN= 0.00 RTIOE= 1.00

UNIT HYDROGRAPH 17 END OF PERIOD ORDINATES, TCE= 0.00 FOURS, LAGE= .25 VOL= 1.00
21. 0. 12H. 100. 1. 1. 1. 37. 24. 15. 9.
0. 0. 2. 1. 1. 0.

END-OF-PERIOD FLOW

NO. DA	HR. IN	PERIOD	RAIN	EXCS	LOSS	COEFF C	NO. DA	HR. IN	PERIOD	RAIN	EXCS	LOSS	COEFF D
1.01	1.00	1	.17	0.00	.17	0.	1.01	1.00	1	.17	0.00	.17	0.
1.01	1.10	2	.17	0.00	.17	0.	1.01	1.10	2	.17	0.00	.17	0.
1.01	1.20	3	.17	0.00	.17	0.	1.01	1.20	3	.17	0.00	.17	0.
1.01	1.30	4	.17	0.00	.17	0.	1.01	1.30	4	.17	0.00	.17	0.
1.01	1.40	5	.17	0.00	.17	0.	1.01	1.40	5	.17	0.00	.17	0.
1.01	1.50	6	.17	0.02	.15	1.	1.01	1.50	6	.17	0.02	.15	1.
1.01	1.55	7	.17	.16	.01	6.	1.01	1.55	7	.17	.16	.01	6.
1.01	1.58	8	.17	.16	.01	20.	1.01	1.58	8	.17	.16	.01	20.
1.01	1.59	9	.17	.16	.01	40.	1.01	1.59	9	.17	.16	.01	40.
1.01	1.59	10	.17	.16	.01	61.	1.01	1.59	10	.17	.16	.01	61.
1.01	1.59	11	.17	.16	.01	76.	1.01	1.59	11	.17	.16	.01	76.
1.01	1.59	12	.17	.16	.01	85.	1.01	1.59	12	.17	.16	.01	85.
1.01	1.59	13	.20	.20	.01	92.	1.01	1.59	13	.20	.20	.01	92.
1.01	1.59	14	.20	.20	.01	98.	1.01	1.59	14	.20	.20	.01	98.
1.01	1.59	15	.20	.20	.01	105.	1.01	1.59	15	.20	.20	.01	105.
1.01	1.59	16	.20	.20	.01	110.	1.01	1.59	16	.20	.20	.01	110.
1.01	1.59	17	.20	.20	.01	115.	1.01	1.59	17	.20	.20	.01	115.
1.01	1.59	18	.20	.20	.01	117.	1.01	1.59	18	.20	.20	.01	117.
1.01	1.59	19	.20	.20	.01	119.	1.01	1.59	19	.20	.20	.01	119.
1.01	1.59	20	.20	.20	.01	120.	1.01	1.59	20	.20	.20	.01	120.
1.01	1.59	21	.20	.20	.01	120.	1.01	1.59	21	.20	.20	.01	120.
1.01	1.59	22	.20	.20	.01	121.	1.01	1.59	22	.20	.20	.01	121.
1.01	1.59	23	.20	.20	.01	121.	1.01	1.59	23	.20	.20	.01	121.
1.01	1.59	24	.20	.20	.01	121.	1.01	1.59	24	.20	.20	.01	121.
1.01	1.59	25	.26	.25	.01	122.	1.01	1.59	25	.26	.25	.01	122.
1.01	1.59	26	.26	.25	.01	127.	1.01	1.59	26	.26	.25	.01	127.
1.01	1.59	27	.26	.25	.01	133.	1.01	1.59	27	.26	.25	.01	133.
1.01	1.59	28	.26	.25	.01	140.	1.01	1.59	28	.26	.25	.01	140.
1.01	1.59	29	.26	.25	.01	145.	1.01	1.59	29	.26	.25	.01	145.
1.01	1.59	30	.26	.25	.01	148.	1.01	1.59	30	.26	.25	.01	148.
1.01	1.59	31	.26	.25	.01	150.	1.01	1.59	31	.26	.25	.01	150.
1.01	1.59	32	.26	.25	.01	151.	1.01	1.59	32	.26	.25	.01	151.
1.01	1.59	33	.26	.25	.01	152.	1.01	1.59	33	.26	.25	.01	152.
1.01	1.59	34	.26	.25	.01	152.	1.01	1.59	34	.26	.25	.01	152.
1.01	1.59	35	.26	.25	.01	153.	1.01	1.59	35	.26	.25	.01	153.
1.01	1.59	36	.26	.25	.01	153.	1.01	1.59	36	.26	.25	.01	153.
1.01	1.59	37	.16	.15	.01	151.	1.01	1.59	37	.16	.15	.01	151.
1.01	1.59	38	.31	.30	.01	146.	1.01	1.59	38	.31	.30	.01	146.
1.01	1.59	39	.31	.30	.01	146.	1.01	1.59	39	.31	.30	.01	146.
1.01	1.59	40	.46	.45	.01	157.	1.01	1.59	40	.46	.45	.01	157.
1.01	1.59	41	.54	.53	.01	181.	1.01	1.59	41	.54	.53	.01	181.
1.01	1.59	42	1.32	1.31	.01	234.	1.01	1.59	42	1.32	1.31	.01	234.
1.01	1.59	43	2.17	2.16	.01	352.	1.01	1.59	43	2.17	2.16	.01	352.
1.01	1.59	44	.85	.84	.01	517.	1.01	1.59	44	.85	.84	.01	517.
1.01	1.59	45	.54	.53	.01	631.	1.01	1.59	45	.54	.53	.01	631.

SUM 20.41 18.80 1.55 11600. 331.20

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
634.	162.	130.	130.	11702.
18.	5.	4.	4.	331.
	18.85	18.80	18.80	18.80
	478.74	480.00	480.00	480.00
	80.	81.	81.	81.
	99.	99.	99.	99.

THOUS (U P

COMBINE HYDROGRAPHS

NEWLON COMBINE INFLOW HYDROGRAPH FOR SUNSET LAKE DAM

ISTAQ	ICOMP	IECON	ITYPE	JFLY	JPRT	INAME	ISTAGE	IAUTC
AG	2	0	0	0	1	1	0	0

SUF OF 2 HYDROGRAPHS AT		AF PLAN 1		RTIO 1	
0.	0.	0.	0.	1.	2.
9.	10.	10.	11.	12.	12.
13.	13.	13.	14.	15.	15.
16.	16.	16.	16.	16.	16.
25.	37.	53.	65.	58.	47.
23.	21.	20.	19.	18.	17.
17.	16.	15.	15.	15.	15.
15.	14.	13.	11.	7.	6.
4.	4.	4.	4.	4.	4.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	66.	18.	15.	15.	1348.
CMS	2.	1.	0.	0.	38.
INCHES		.46	.47	.47	.47
PM		11.52	11.96	11.96	11.96
AC-FT		9.	9.	9.	9.
THOUS CU W		11.	11.	11.	11.

	SUM OF 2 HYDROGRAPHS AT				A6 PLAN 2				RTIO 2				
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
3.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
4.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
5.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
6.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
7.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
8.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
9.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
10.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
11.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
12.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
13.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
14.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
15.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
16.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
17.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
18.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
19.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
20.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
21.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
22.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
23.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
24.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
25.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
26.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
27.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
28.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
29.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
30.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
31.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
32.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
33.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
34.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
35.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
36.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
37.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
38.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
39.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
40.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
41.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
42.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
43.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
44.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
45.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
46.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
47.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
48.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
49.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
50.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
51.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
52.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
53.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
54.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
55.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
56.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
57.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
58.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
59.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
60.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
61.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
62.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
63.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
64.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
65.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
66.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
67.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
68.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
69.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
70.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
71.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
72.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
73.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
74.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
75.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
76.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
77.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
78.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
79.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
80.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
81.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
82.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
83.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
84.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
85.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
86.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
87.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
88.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
89.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
90.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
91.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
92.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
93.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
94.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
95.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
96.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
97.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
98.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
99.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
100.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	16.4	51.	47.	47.	383.8.
CFS	5.	1.	1.	1.	10.9.
INCHES		1.28	1.34	1.34	1.34
MM		32.44	34.04	34.04	34.04
AC-FT	25.	25.	26.	26.	26.
THOUS CU YD	31.	31.	23.	23.	33.

SUM OF 2 HYDROGRAPHS AT A6 PLAN 3 R110 3

	0.	43.	0.	0.	0.	53.	56.	1.	3.	10.	21.	31.
39.	47.	63.	81.	199.	320.	446.	512.	515.	215.	206.	199.	194.
62.	81.	131.	275.	252.	237.	157.	151.	143.	147.	140.	138.	138.
79.	100.	181.	129.	118.	103.	87.	74.	65.	57.	52.	52.	52.
100.	136.	43.	40.	37.	34.	32.	30.	27.	26.	24.	24.	24.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

	615.	147.	121.	121.	10907.
CFS	15.	4.	3.	3.	309.
CMS	3.70	3.81	3.81	3.81	3.81
INCHES	94.04	96.73	96.73	96.73	96.73
AC-FT	73.	75.	75.	75.	75.
THOUS CU M	90.	93.	93.	93.	93.

HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH IMPOUNDMENT

ISTAO	ICOMP	IECON	ITAPF	JPLI	JPRI	INAME	ISTAGE	IAUTO
A7	1	0	0	0	1	1	0	0

ALL PLANS HAVE SAME

OLDS	CLCSS	AVG	IRCS	ISAME	INPT	IPNP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
0	0	0	0.000	0.000	0.000	-522.	-1

STAGE	522.20	522.30	522.50	523.00	523.50	524.00	524.50	525.00
FLOW	0.00	6.30	142.00	453.00	967.00	2095.00	2503.00	

CAPACITY= 74. 74. 103.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	24.	12.	9.	9.		848.
CPS	1.	0.	0.	0.		24.
INCHES		0.	30	30		30.
"		7.37	7.52	7.52		7.52
AC-FT		6.	6.	6.		6.
THOUS CU F		7.	7.	7.		7.

STATION A7, PLAN 2, RATIO 2

[illegible][illegible][illegible]

PEAK OUTLOOK IS: 4.17 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFE	86.	43.	35.	35.		3141.
CM	2.	1.	1.	1.		89.
INCHES		1.09	1.10	1.10		1.10
MM		27.66	27.66	27.66		27.86
AC-FT		21.	22.	22.		22.
CU M		26.	27.	27.		27.

END-OF-PERIOD HYDROGRAPH ORDINATES

STORAGE									
74.	74.	74.	74.	74.	74.	74.	74.	74.	74.
75.	75.	75.	76.	76.	76.	77.	77.	77.	78.
76.	79.	79.	79.	79.	79.	80.	80.	80.	80.
80.	81.	81.	81.	81.	81.	81.	81.	81.	81.
82.	84.	85.	88.	88.	89.	91.	92.	92.	92.
92.	91.	90.	90.	90.	90.	89.	89.	89.	89.
88.	88.	87.	87.	87.	87.	87.	86.	86.	86.
86.	86.	86.	86.	85.	85.	85.	85.	84.	84.
83.	82.	82.	82.	82.	82.	81.	81.	81.	81.

PEAK OUTFLOW IS 352. AT TIME 4.25 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
CFS	362.	138.	110.	110.	993R.
CMS	10.	4.	7.	3.	281.
INCHES		3.46	3.47	3.47	
MM		87.85	88.15	88.15	
AC-FT		68.	68.	68.	68.
THOUS CU M		84.	84.	84.	84.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION STATION AREA PLAN RATIO 1 RATIO 2 RATIO 3
 .10 .25 .50

HYDROGRAPH AT A1 .20 1 6.
 (.52) (.17)
 2 22.
 (.62)
 3 190.
 5.38)

HYDROGRAPH AT A2 .09 1 .75.
 (.23) (2.70)
 2 239.
 6.75)
 3 477.
 13.51)

2 COMBINED A3 .29 1 100.
 (.75) (2.84)
 2 247.
 6.98)
 3 592.
 16.76)

ROUTED TO A4 .29 1 4.
 (.75) (.11)
 2 28.
 .78)
 3 252.
 7.15)

HYDROGRAPH AT A5 .08 1 63.
 (.21) (1.80)
 2 159.
 4.49)
 3 317.
 8.98)

2 COMBINED A6 .37 1 66.
 (.96) (1.86)
 2 174.
 4.65)
 3 515.
 14.58)

ROUTED TO A7 .37 1 24.
 (.96) (.68)
 2 86.
 2.43)
 3 362.
 10.24)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION		522.30	522.20	522.30
STORAGE		74.	74.	74.
OUTFLOW		1.	0.	1.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.-ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	522.57	.27	79.	24.	6.75	4.33	0.00

PLAN 2		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION		522.30	522.20	522.30
STORAGE		74.	74.	74.
OUTFLOW		1.	0.	1.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.-ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.25	522.79	.49	82.	86.	6.92	4.17	0.00

PLAN 3		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION		522.30	522.20	522.30
STORAGE		74.	74.	74.
OUTFLOW		1.	0.	1.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.-ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	523.35	1.05	92.	362.	6.92	4.25	0.00

APPENDIX 4

REFERENCE

SUNSET LAKE DAM

APPENDIX 4

REFERENCES

SUNSET LAKE DAM

1. U.S. Army Corps of Engineers, Hydrologic Engineering Center, "Flood Hydrograph Package (HEC-1) for Dam Safety Inspections-User's Manual," Davis, California, September 1978.
2. Brater, Ernest F. and King, Horace, Handbook of Hydraulics, Sixth Edition, McGraw-Hill, New York, 1976.
3. U.S. Bureau of Public Roads, "Design charts for Open Channel Flow," October 1960.
4. Reference Data, Dams in New Jersey, No. 25-121 from New Jersey Department of Environmental Protection files, dated June 5, 1939.
5. "Workshop Notes on Storm Sewer System Design," Edited by Ben Chie Yen, Dep. of Civil Engineering, Univ. of Illinois at Urbana-Champaign, 1978.
6. Schwab, G.O., R.K. Frevert, T.W. Edmister, and K.K. Barnes, Soil and Water Conservation Engineering, The Ferguson Foundation Agricultural Engineering Series, John Wiley and Sons, Inc., New York, 1966, 683 pp.
7. United States Department of Interior, Bureau of Reclamation, Design of Small Dams, U.S. Government Printing Office, Washington, 1977, 816 pp.
8. U.S. Department of Interior, Geological Survey, 7.5-Minute Series (topographic) maps, scale 1:24000, Contour Interval 20 feet: Boonton, N.J., (1954).
9. U.S. Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release NO. 55, Washington, 1975, 3.7 pp.
10. U.S. Department of Commerce, Weather Bureau, "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 square Miles and Durations of 6, 12, 24, and 48 hours," Hydrometeorological Report NO. 33, Washington, 1977, 816 pp.
11. Department of the Army, Philadelphia District, Corps of Engineers, Pennsylvania 19106. Birchwood Lake Dam - Phase I Inspection Report, National Dam Safety Program, August 1979.
12. Department of the Army, Philadelphia District, Corps of Engineers, Pennsylvania 19106. Crystal Lake Dam - Phase I Inspection Report, National Dam Safety Program, August 1979.